CENTRAL VALLEY FLOOD MANAGEMENT PLANNING PROGRAM

FloodSAFE CALIFORNIA

Central Valley Flood Protection Plan

Round 1 Management Action Workshops
Draft Initial Management Actions

A management action is a specific structural or nonstructural strategy, action, or tactic that contributes to the Central Valley Flood Protection Plan (CVFPP) goals and addresses identified flood management problems in the Systemwide Planning Area, including any identified deficiencies in the State Plan of Flood Control (refer to *CVFPP Interim Progress Summary No.1*). Management actions may range from potential policy or institutional changes, to recommendations for operational and physical changes to the flood management system. Management actions may address one or more CVFPP goals and are the "building blocks" for regional solutions and eventually systemwide solutions.

An initial set of management actions was developed by consolidating a large number of compiled actions and recommendations from published studies and reports, and input from Regional Conditions and Topic Work Groups during CVFPP Phase 1 activities. DWR subject-matter experts provided a preliminary evaluation of the environmental, economic, technical, and social consideration of the identified management actions. Each management action was evaluated against a uniform set of criteria to allow for a consistent comparative analysis.

Management Actions Workshops will refine the initial management actions and develop additional actions to augment this initial set of management actions. For information on Phase 2 Workshops, refer to *Attendee's Guide to Phase 2 Workshops* available at www.water.ca.gov/cvfmp/.

Each management action is evaluated using the *Management Actions Evaluation Form*. For description of the form sections refer to the *Reader's Guide to the Management Actions Evaluation Form* available at www.water.ca.gov/cvfmp/.

To provide detailed written comments on the management action description and evaluation, use the fillable PDF *Comments Form* available at www.water.ca.gov/cvfmp/.

Draft Flood Protection System Modification Management Actions

ID	Management Actions Title
MA-016	Improve conveyance and facilitate habitat restoration by reducing flow constrictions.
MA-017	Increase capacity of existing bypasses.
MA-018	Modify existing weirs or overflows to improve flood system performance.
MA-019	Construct new bypasses to improve flood system performance.
MA-020	Construct new levees to expand existing system capability.
MA-021	Raise levees to improve flood system performance.
MA-022	Construct setback levees.
MA-023	Construct ring levees.
MA-024	Improve structural performance of existing levees.

DRAFT Management Action Evaluation

Management Action Title: MA-016

Improve conveyance and facilitate habitat restoration by reducing flow constrictions.

Description:

Problem:

Bridges, marinas, in-channel structures, sedimentation, and hard points can affect the hydraulics of channels and bypasses by constricting and slowing flood flows. They can also trap large debris during flood events, which can create significant backwater effects and further reduce flood flow capacity.

Desired Outcome:

Increase channel or bypass flood conveyance capacity by reducing impedance to flood flow, where feasible.

Methodology:

Removal, modification, or relocation of flow constrictions and hardpoints can increase overall channel capacity and/or reduce flooding upstream. Specific actions or treatments would depend on the type of flow constriction or hard point. For example, existing bridges that impede flood flows could be removed, replaced, or modified/raised to improve conveyance; new bridges within designated floodways could be constructed to standards that prohibit constraints on conveyance capacity and reduce backwater effects. Dredging and sediment removal could be used to reduce other types of flow constrictions. Marinas or other flow impediments could be modified or relocated to prevent accumulation of debris during floods. Changing the physical features of the conveyance system to reduce flow constrictions could also provide opportunities to restore ecosystem functions or habitats. For example, removing rock revetment, dikes, or other structures in the channel in conjunction with setback levee construction could promote natural erosion and deposition processes and provide opportunities for riparian habitat restoration; wetland, shallow water, or terrestrial habitats could also be established in conjunction with projects to reduce flow constrictions and improve flood flow capacity.

CVFPP Goals

Contributes Significantly to: Improve Flood Risk Management

Potentially Contributes to (Check all that apply):

- [x] Improve Flood Risk Management
- [x] Improve Operation and Maintenance
- [x] Promote Ecosystem Functions
- [ ] Improve Institutional Support
- [ ] Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retained; requires further evaluation to identify flow constrictions and specific actions to address them

Advantages:

• Increases channel capacity and reduces flood risk.
• Works well in conjunction with other actions that increase system capacity and/or reliability
• Potential to combine with other actions to improve ecosystem functions, habitat.
• Potential to reduce O&M costs associated with debris removal or erosion repairs

Disadvantages:

• Potentially high capital cost.
• For bridge modifications, potential for traffic distruption.
• Channel modification (such as dredging), potential for water quality or other aquatic impacts.
• Permitting and mitigation may be costly, extensive and lengthy.

Economic Considerations:

Capital Cost? (High, Medium, Low)

Potentially high initial investment depending on number and type of flow constrictions to be removed, replaced, or modified; bridge modifications or replacements could be costly�Permitting and mitigation costs could also be high�Potentially high cost for levee realignment

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

May reduce O&M costs associated with debris removal and erosion repairs after floodsHowever, O&M costs may increase if sediment removal is completed on a regular basisO&M costs may increase to protect embankments and repair other damage to structures that can be eroded as a result of changes in the flow regime

Potential for Cost-Sharing?

Potential for Federal cost sharing via contributions to existing Federal project purposes (flood management)Potential also exists for system-wide cost sharing between locals, depending on the range of effects from the actionFor example, funds to replace functional or structurally deficient bridges can come from highway bridge replacement and rehabilitation program

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Potential to reduce long-term costs for emergency response and recovery through reduction in the frequency or magnitude of flooding due to increased channel conveyance capacity

Flood fighting? (Increase, Decrease, or No Significant Change)

Potential to reduce the long-term cost of floodfighting through reduction in the frequency or magnitude of flooding and reduction in debris removal actions during floods

Effect on Damage to Critical Public Infrastructure?

Potential to reduce damage to critical public infrastructure through reduction in the frequency or magnitude of flooding due to increased channel capacityPotoential improvement to infrastructure

Effect on Floodplain and Economic Development?

No direct effects; however, reduces the frequency of flooding and increases level of flood protection, which may encourage development in floodplain areas receiving benefits

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Potential to reduce State liability through reduction in the frequency or magnitude of flooding due to increased channel capacity

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

Reducing flow constrictions and hard points could also contribute to rehabilitating physical processes, including sediment transport and channel forming processes, and could improve aquatic and riparian habitat (particularly if incorporated into design and implementation)

Adverse Environmental Impact?

Reducing flow constrictions and removing hard points would result in minor to moderate temporary impacts during construction (and potentially permanent impacts) to aquatic and riparian habitats and associated species, particularly if habitat is not incorporated into design and implementation

Permitting Considerations?

High for most types of flow constrictions

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

By reducing constrictions, there is the potential to reduce the need for O&M, and therefore reduce the negative environmental impacts asociated with O&M operations (assuming these improvements are designed so they do not increase erosion)O&M could be done at regular intervals, and could possibly be scheduled for times when the environmental impacts are minimal

Social Considerations:

Public Safety?

Potential to increase public safety through reduction in the frequency or magnitude of flooding due to increased channel capacity; no residual risk

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

None

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Dependent on site/location and type of flow constriction; for bridges, likelihood of imlementation would depend typen (vehicle versus rail), capacity, deisgn, and other factors�For marinas, in-channel structures, sedimentation, and hard points other implementation factors may include ownership, ability to relocate, and other jurisdictional issues

Technical Considerations:

Redirected Hydraulic Impacts?

Increasing channel capacity can potentially increase downstream flood flows and stages and potentially affect sediment deposition and/or erosion

Residual Risk?

No change in residual risk

Climate Change Adaptability:

No direct effects

Urban, Small Community, and Non-Urban Considerations:

Location specific (cannot determine at this time)

Regional Applicability:

Applicable in all regions where hard points and constrictions exist�However, further evaluation may be needed; cost-to-benefit ratio may preclude applicability

Integration with Other Programs:

Channel maintenance technical evaluations including hydraulic models and conveyance analysis (FMO), Evaluation of Hydraulic Carrying Capacity of Channels (HAFOO), Bridge Inspection Program (FMO)

References:

Environmental Sustainability Summary; Boyle & Associates, 2008. Madera County Integrated Regional Water Management Plan; RCR; Colusa Basin IRWMP;

ID #: MA-017

DRAFT Management Action Evaluation

Management Action Title: MA-017

Increase capacity of existing bypasses.

Description:

Problem:

Some bypasses have insufficient capacity to convey flood flows, or cannot convey intended design capacities due to changed channel conditions.

Desired Outcome:

Increase or restore the flood conveyance capacity of existing bypasses.

Methodology:

This measure could include widening or expanding the footprint of existing bypasses, or raising levees or berms along existing bypasses to create more flood carrying capacity. It may also require the reconstruction and/or re-operation of existing flow control weirs that direct flood flows into bypasses. This measure could also include sediment removal or vegetation control. Increasing the capacity of certain bypasses could provide opportunities for habitat, recreation, and agricultural enhancement; these functions would be integrated into the evaluation of specific actions.

CVFPP Goals

Contributes Significantly to: Improve Flood Risk Management

Potentially Contributes to (Check all that apply):

- [x] Improve Flood Risk Management
- [ ] Improve Operation and Maintenance
- [x] Promote Ecosystem Functions
- [ ] Improve Institutional Support
- [ ] Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retained; requires further evaluation to determine how existing bypasses could be modified to increase flood flow capacity

Advantages:

• Increases channel capacity and reduces flood risk.
• Potential to combine with other actions to improve or restore habitat

Disadvantages:

• Moderate to high capital cost to widen bypasses, raise bypass levees, or reconstruct/modify weirs.
• Permitting and associated mitigation as well as additional vegetation maintenance could be costly and time consuming.

Economic Considerations:

Capital Cost? (High, Medium, Low)

Moderate to high capital cost to implement reoperation of weir changes, widen bypasses, raise bypass levees, or reconstruct weirs

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

Potential to increase O&M costs for vegetation control and management Potential to decrease O&M costs if modifications are constructed to new design standards; less maintenance may be required

Potential for Cost-Sharing?

Potential for Federal cost sharing via contributions to existing Federal project purposes (flood management)

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Potential to reduce long-term costs for emergency response and recovery through reduction in the frequency or magnitude of flooding due to increased flood conveyance capacity

Flood fighting? (Increase, Decrease, or No Significant Change)

Potential to reduce the long-term cost of floodfighting through reduction in the frequency or magnitude of flooding due to increased flood conveyance capacity

Effect on Damage to Critical Public Infrastructure?

Potential to reduce damage to critical public infrastructure through reduction in the frequency or magnitude of flooding due to increased flood conveyance capacity

Effect on Floodplain and Economic Development?

No direct effects; however, reduces the frequency of flooding and increases level of flood protection, which may encourage development in floodplain areas receiving benefits

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Potential to reduce State liability through reduction in the frequency or magnitude of flooding due to increased flood convneyance capacity

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

In combination with other actions, increasing the capacity of existing bypasses could enhance key physical processes and ecological functions by restoring more natural flow regime to bypasses within historic overflow areas (potential to restore channel and floodplain forming processes and improve salmonid rearing)

Adverse Environmental Impact?

Increasing the capacity of existing bypasses by widening could result in substantial permanent impacts including loss of upland habitat and effects on associated species

Permitting Considerations?

Extensive, complex, and potentially costly

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

None

Social Considerations:

Public Safety?

Potential to increase public safety through reduction in the frequency or magnitude of flooding due to increased flood conveyance capacity; no change in residual risk

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

None

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Bypass modification likely to be more feasible/implementable than construction of new bypasses

Technical Considerations:

Redirected Hydraulic Impacts?

Increasing bypass capacity can potentially increase downstream flood flows and stages

Residual Risk?

No change in residual risk

Climate Change Adaptability:

Increasing the capacity of existing bypasses could enhance hydrologic adaptability by increasing water management flexibility; could potentially enhance biological adaptability by increasing the quantity of aquatic and riparian habitats and thus the ability of associated species to adjust to changing climate conditions

Urban, Small Community, and Non-Urban Considerations:

Location specific (cannot determine at this time)

Regional Applicability:

Applicable in all regions where bypasses exist

Integration with Other Programs:

Channel maintenance technical evaluations including hydraulic models and conveyance analysis (FMO, FPO), Hydraulic Structures Inspection and Rehabilitation Program (FMO), Evaluation of Hydraulic Carrying Capacity of Channels (HAFOO)

References:

USACE 2001 Sacramento and San Joaquin River Basins Comprehensive Study;RCR; Delta Risk Management Strategy;

DRAFT Management Action Evaluation

Management Action Title: MA-018

Modify existing weirs or overflows to improve flood system performance.

Description:

Problem:

The outdated design of current flood relief structures, while providing flood control, also create areas of debris and sediment accumulation. The performance and operation of weirs and flood overflows can be negatively affected by factors such as accumulation of sediment or debris, downstream flow restrictions, antiquated control systems, subsidence, erosion, structural deficiencies, and functional obsolescence.

Desired Outcome:

Improve flood system operations by modifying existing weirs and overflows.

Methodology:

Aspects of the flood management system are controlled or operated via weirs (both with and without gates) and overflows (such as lowered segments of levees designed to permit overflows at certain stages) to divert flood flows to the bypasses and for irrigation during non-flood season. Weirs could be modified in several ways (raised, lowered, lengthened, or automated) depending upon the operation and desired effect. For example, a weir crest could be raised to prevent flows from entering a storage area too early in a flood event, thereby reserving storage space for the storm peak. Alternately, weirs could be lengthened to pass more flow into a bypass at the same stage, or lowered to divert flow at lower stages. Other modifications could include removal of sediment or debris to improve the intended performance of the weir. Weir modifications could also be designed to provide opportunities to restore ecosystem functions or habitats, reduce O&M, and improve safety. For example, improvements to weirs could allow greater fish passage, change the flow split, manage sediment deposition, or increase the safety of weir operations (floodgates).

CVFPP Goals

Contributes Significantly to: Improve Flood Risk Management

Potentially Contributes to (Check all that apply):

- [x] Improve Flood Risk Management
- [x] Improve Operation and Maintenance
- [x] Promote Ecosystem Functions
- [ ] Improve Institutional Support
- [ ] Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retained; requires further evaluation

Advantages:

• Potential to increase flood conveyance capacity and reduce flood risk.
• Potential to increase safety of flood management operations.

Disadvantages:

• Moderate to high capital cost to raise, lower, lengthen, reoperate, or automate some weirs.

Economic Considerations:

Capital Cost? (High, Medium, Low)

Moderate to high capital cost to raise, lower, lengthen, or automate weirs depending on the type, operation, and desired effect

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

Potential to reduce O&M costs if weir operations are automated or modified to reduce sediment/debris removal requirements

Potential for Cost-Sharing?

Potential for Federal cost sharing via contributions to existing Federal project purposes (flood management)

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Potential to reduce long-term costs for emergency response and recovery through reduction in the frequency or magnitude of flooding

Flood fighting? (Increase, Decrease, or No Significant Change)

Potential to reduce the long-term cost of floodfighting through reduction in the frequency or magnitude of flooding

Effect on Damage to Critical Public Infrastructure?

Potential to reduce damage to critical public infrastructure through reduction in the frequency or magnitude of flooding

Effect on Floodplain and Economic Development?

No direct effects; however, reduces the frequency of flooding and increases level of flood protection, which may encourage development in floodplain areas receiving benefits

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Potential to reduce State liability through reduction in the frequency or magnitude of flooding if weir modifications increase channel capacity.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

Weirs could be modified to facilitate operations that enhance key physical processes and ecological functions (restoring more natural flow regimes, for example); depending on implementation, operational changes could benefit channel and floodplain forming processes and salmonid rearing

Adverse Environmental Impact?

Depending on implementation, the modification of weirs could moderatley alter physical processes downstream, including flow regime (e.g., seasonality, magnitude, and duration of flows) and sediment transport, that could result in permanent impacts (either beneficial or detrimental) to habitat for aquatic and riparian species

Permitting Considerations?

Substantial

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

None

Social Considerations:

Public Safety?

Potential to increase public safety through reduction in the frequency or magnitude of flooding

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

None

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Reoperation of some weirs my provide some benefits with little cost

Technical Considerations:

Redirected Hydraulic Impacts?

Weir modification and reoperation could increase flows to the bypasses; these impacts would need to be mitigated if downstream channel capacities could not accommodate increased flows

Residual Risk?

No change in residual risk

Climate Change Adaptability:

Modifying weirs could enhance hydrologic adaptability by increasing water management flexibility

Urban, Small Community, and Non-Urban Considerations:

Location specific (cannot determine at this time)

Regional Applicability:

Applicable for weirs and overflow structures that are essential to the operation and maintenance of the flood control system

Integration with Other Programs:

Hydraulic Structures Inspection Program (FMO), Channel Evaluation Program (FMO)

References:

USACE 2001 Sacramento and San Joaquin River Basins Comprehensive Study;

DRAFT Management Action Evaluation

Management Action Title: MA-019

Construct new bypasses to improve flood system performance.

Description:

Problem:

Some reaches of the flood management system have insufficient flow capacity.

Desired Outcome:

To provide relief to the areas of the flood conveyance system that do not have the capacity to provide the required level of flood protection by constructing new bypasses to add capacity.

Methodology:

New bypasses could be constructed to work with existing flood management channels and facilities, redirecting flood flows away from protected areas or reaches with insufficient flow capacity and carrying high frequency flow events. Specific actions would take into consideration various factors, including: the topography of the proposed bypass location, the magnitude of flow that would be redirected, hydraulic impacts to areas downstream from the proposed bypass, opportunities for habitat, recreation, and agricultural enhancement, and real estate requirements along the bypass route.

CVFPP Goals

Contributes Significantly to: Improve Flood Risk Management

Potentially Contributes to (Check all that apply):

- [x] Improve Flood Risk Management
- [x] Improve Operation and Maintenance
- [x] Promote Ecosystem Functions
- [ ] Improve Institutional Support
- [x] Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retained; requires further evaluation

Advantages:

- Increases channel capacity and reduces flood risk.
- Potential to integrate ecosystem restoration/habitat.
- Potential to provide or maintain other benefits (agriculture, recreation, groundwater recharge).

Disadvantages:

- High capital cost to construct new bypasses and aquire real estate; choosing the best locations may be difficult due to existing development.
- Potential medium to high costs for environmental obligations (including mitigation) and long-term O &M and/or vegetation management.

Economic Considerations:

Capital Cost? (High, Medium, Low)

High initial investment depending on location and extent of the bypasses (costs inclue real estate acquisitions, mitigation costs, and bypass construction costs).

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

New O&M costs would be associated with the construction of new bypasses

Potential for Cost-Sharing?

Potential for Federal cost sharing via contributions to existing Federal project purposes (flood management)

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Potential to reduce long-term costs for emergency response and recovery through reduction in the frequency or magnitude of flooding

Flood fighting? (Increase, Decrease, or No Significant Change)

Potential to reduce the long-term cost of floodfighting through reduction in the frequency or magnitude of flooding and diversion of high flows from reaches with insufficient channel capacitiy or deficient levees However, the addition of a new bypass adds a structure to the facilities that must now be patrolled/monitored and could possibly fail in a flood situation

Effect on Damage to Critical Public Infrastructure?

Potential to reduce damage to critical public infrastructure through reduction in the frequency or magnitude of flooding

Effect on Floodplain and Economic Development?

No direct effects; however, reduces the frequency of flooding and increases level of flood protection, which may encourage development in floodplain areas receiving benefits

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Potential to reduce State liability through reduction in the frequency or magnitude of flooding due to increased channel capacity

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

New bypasses could be designed to enhance key physical processes and ecological functions (restoring flood flows to historic flood basins or overflow areas, rehabilitating floodplain forming processes, and riparian and seasonal wetland habitat development)

Adverse Environmental Impact?

Constructing new bypasses would result in moderate to substantial permanent impacts to terrestrial and agricultural habitats, including potential loss of habitat for associated special-status species; potential for minor to moderate alteration of physical processes downstream, including flow regime (e.g., seasonality, magnitude, and duration of flows) and sediment transport, that could result in permanent impacts to habitat for aquatic and riparian species

Permitting Considerations?

Extensive and complex

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

Creation of new habitat for floodplain-dependent species could reduce the adverse impacts of the flood management system by restoring part of the system

Social Considerations:

Public Safety?

Potential to increase public safety through reduction in the frequency or magnitude of flooding

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

Potential for ecosystem restoration, recreation, and agriculture to be integrated to maximize overall project benefits

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Feasibility would be highly dependent on location (real estate requirements, land uses or infrastructure affected), cost, and magnitude of benefits provided; new bypasses that provide mutliple benefits would have a higher likelihood of acceptability and implementation

Technical Considerations:

Redirected Hydraulic Impacts?

Bypasses could increase flows to downstream reaches; these impacts would need to be mitigated if downstream channel capacities could not accommodate increased flowsModulation of the flow should be a major design consideration so that the volume or flow downstream of the confluence is less than that would have occur without the bypass

Residual Risk?

No change in residual risk

Climate Change Adaptability:

Constructing new bypasses could enhance hydrologic adaptability by increasing water management flexibility; could also enhance biological adaptabiity by increasing habitat quantity, connectivity, and complexity, thus enhancing the ability of populations to adjust to the consequences of climate change

Urban, Small Community, and Non-Urban Considerations:

Location specific (cannot determine at this time)

Regional Applicability:

Applicable in regions where additional channel capacity is needed and locations for new bypasses exist; new bypasses are not applicable within Delta region

Integration with Other Programs:

Integrated Regional Water Management Program, State Water Project, Central Water Project

References:

USACE 2001 Sacramento and San Joaquin River Basins Comprehensive Study;RCR; Delta Risk Management Strategy; Colusa Basin IRWMP;Integrated Regional Water Plan

DRAFT Management Action Evaluation

Management Action Title: MA-020

Construct new levees to expand existing system capability.

Description:

Problem:

Insufficient flow capacity in some non-leveed reaches of the flood management system due to changes in the channel hydraulics, landuse patterns, and environmental conditions.

Desired Outcome:

Increase system capacity by constructing new levees.

Methodology:

New levees could be constructed along river reaches where no levees are currently present to increase the carrying capacity of the existing river channel and modulate peak flows. By modifying the flow regime, new levees constructed upstream of urban areas may be an effective measure in lowering the risk of flooding. Levee construction may not be feasible in all urban areas due to high cost of land acquisition. However, in some urban areas, there may be no other measures capable of managing floodflows.

CVFPP Goals

Contributes Significantly to: Improve Flood Risk Management

Potentially Contributes to (Check all that apply):

- [x] Improve Flood Risk Management
- [ ] Improve Operation and Maintenance
- [ ] Promote Ecosystem Functions
- [ ] Improve Institutional Support
- [ ] Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retain for further evaluation; look for opportunity.

Advantages:

• Reduces the chances of inundation.

Disadvantages:

• Potentially high capital cost.
• May result in downstream hydraulic impacts due to increased channel capacity.
• Potential for long permitting process, legal issues due to land acquisition, and high mitigation costs from environmental impacts

Economic Considerations:

Capital Cost? (High, Medium, Low)

High capital costs, dependant on location and amount of new levee construction. Costs include construction, permitting, mitigation, real estate acquisitions, and relocations.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

Increased O&M costs proportional to amount of new levee construction.

Potential for Cost-Sharing?

Opportunities to partner with USACE and locals

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Likely reduction in long-term costs for emergency response and recovery through reduction in frequency of flooding.

Flood fighting? (Increase, Decrease, or No Significant Change)

Likely reduction in floodfighting costs through reduction in frequency of flooding.

Effect on Damage to Critical Public Infrastructure?

Reducing the risk of flooding reduces the likelihood of damage to critical public infrastructure.

Effect on Floodplain and Economic Development?

Reduces the frequency of flooding and increases level of flood protection, which may encourage development in the floodplain

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Potential to expand State flood responsibility by increasing the project-levee system.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

None

Adverse Environmental Impact?

Substantial permanent impacts to terrestrial, riparian and shaded riverine aquatic habitats including loss of habitat for special-status species, and may cut-off species by inhibiting access to habitat areas. Substantial alteration of physical processes, including flow regime (e.g., seasonality, magnitude, and duration of flows) and sediment transport, that could result in permanent impacts to habitat for aquatic and riparian species.

Permitting Considerations?

Extensive and complex

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

None

Social Considerations:

Public Safety?

Improves level of flood protection by reducing the frequency of flooding; residual risk remains and may increase if floodplain development increases.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

No other benefits identified

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Improving the level of flood protection is politically desirable, particularly in urban and urbanizing areas. However, high capital costs and environmental impacts may present a challenge to widespread implementation.

Technical Considerations:

Redirected Hydraulic Impacts?

If the new levees increase the carrying capacity of the channel and constrict additional flows in the channel, downstream impacts may result, particularly in downstream areas with lower levels of flood protection. However, if new levees are used to modulate flow peaks, reduced impacts may be experienced downstream.

Residual Risk?

Reduces the frequency of flooding. May increase residual risk if floodplain development is encouraged.

Climate Change Adaptability:

Constructing new levees would enhance hydrologic adaptability by increasing system capacity. However, this action would reduce biological adaptability by reducing quantity and complexity of floodplain habitats, and the continuity of these habitats along environmental gradients; and thus, reducing the ability of species to handle and adjust to the consequences of climate change.ability to maintain floodplain species and habitats under more extreme conditions

Urban, Small Community, and Non-Urban Considerations:

Construction of new levees may be benefit small comunities. Construction of new levees in urban areas depend on land availability and feasibility of other flood protection measures.

Regional Applicability:

Dependent upon site factors, land availability, and financing.

Integration with Other Programs:

Flood Projects Office; transportation corridors;

References:

USACE 2001 Sacramento and San Joaquin River Basins Comprehensive Study;

DRAFT Management Action Evaluation

Management Action Title: MA-021

Raise levees to improve flood system performance.

Description:

Problem:

There are several reaches along the flood control levees with insufficient freeboard (less than 3 ft along rivers and less than 6 feet along bypasses). The freeboard is referenced to either a 100-year flood or the 1955/1957 water surface profile. With current hydraulic analyses being performed to estimate water surface elevation for a 200-year flood, it is likely that additional reaches will have insufficient freeboard.

Desired Outcome:

Provide an adequate level of freeboard and increase the conveyance capacity of the channel adjacent to the levee by raising levees.

Methodology:

Raising levees could allow larger design flows, or larger project flows, to pass with adequate freeboard. Specific actions would take into consideration various factors, including: the need to perform a geotechnical evaluation of the structural integrity of the levee for stability and seepage; land use and corresponding level of safety needs on either side of the levee which may be different; and modification of some privately owned levees, which provide significant benefits or are essential to management of the system, which would require adoption of these structures by either the Central Valley Flood Protection Board or Corps.

CVFPP Goals

Contributes Significantly to: Improve Flood Risk Management

Potentially Contributes to (Check all that apply):

- [x] Improve Flood Risk Management
- [ ] Improve Operation and Maintenance
- [ ] Promote Ecosystem Functions
- [ ] Improve Institutional Support
- [ ] Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retain for further evaluation; look for opportunity.

Advantages:

• Reduces the chances of levee overtopping.

Disadvantages:

• Potentially high capital cost due enlargement of levee footprint.
• May result in downstream hydraulic impacts due to increased channel capacity.
• Raising levees and formal adoption as a federal project levee could transfer maintenance responsibility to DWR, thus increasing maintenance costs and time.

Economic Considerations:

Capital Cost? (High, Medium, Low)

High capital cost because raising levee will likely require acquiring additional real estate. Small levee raise (less than 2 feet) could be perform with flood walls, in which case the capital cost is relatively low.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

Minimum or no significant increase in annual maintenance costs.

Potential for Cost-Sharing?

Opportunities to partner with USACE and locals

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Likely reduction in long-term costs for emergency response and recovery through reduction in frequency of flooding.

Flood fighting? (Increase, Decrease, or No Significant Change)

Marginal to moderate decrease in flood fighting. Flood fighting cost due to insufficient freeboard are reduced, but other forms of flood fighting (boils, wavewash erosion, river erosion) are likely to remain unchanged.

Effect on Damage to Critical Public Infrastructure?

Reducing the risk of flooding reduces the likelihood of damage to critical public infrastructure.

Effect on Floodplain and Economic Development?

Reduces the frequency of flooding and increases level of flood protection, which may encourage development in the floodplain

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Potential to reduce State flood responsibility by reducing the frequency of overtopping. However, State flood resonsibility may increase if the floodplain and economic development above occurs. Responsibilities to maitain facilities remain unchanged.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

None

Adverse Environmental Impact?

Raising levees could result in substantial permanent impacts to terrestrial habitat including loss of habitat for special-status species. This action also could moderately alter physical processes (including sediment transport) that could result in permanent impacts to habitat for aquatic and riparian species.

Permitting Considerations?

Extensive and complex

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

None

Social Considerations:

Public Safety?

Improves level of flood protection by reducing the frequency of flooding; residual risk remains and may increase if floodplain development increases.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

No other benefits identified

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Improving the level of flood protection is politically desirable, particularly in urban and urbanizing areas.

Technical Considerations:

Redirected Hydraulic Impacts?

Increasing the carrying capacity of the channel may result in downstream impacts, particularly in downstream areas with lower levels of flood protection. Additional flood flows that would have historically escaped channel would be conveyed downstream.

Residual Risk?

Reduces the frequency of flooding. May increase residual risk if floodplain development is encouraged.

Climate Change Adaptability:

Raising levees could enhance hydrologic adaptability by increasing system capacity. However, this action could adversely impact biological adaptibiity by reducing ability to for floodplain species and habitats to handle more extreme conditions.

Urban, Small Community, and Non-Urban Considerations:

Raising existing levees may be most appropriate in established urban areas where land is at a premium and other flood protection measures are not feasible. Considerations should also be given to the height of levees bordering both banks of a river or channel; as raising only one side may impact the risk of flooding the opposite side.

Regional Applicability:

Raising levees can be performed systemwide, provided adjacent land is available for landside toe migration.

Integration with Other Programs:

Flood Projects Office; Channel Evaluation Program

References:

USACE 2001 Sacramento and San Joaquin River Basins Comprehensive Study;

DRAFT Management Action Evaluation

Management Action Title: MA-022

Construct setback levees.

Description:

Problem:

Insufficient flow capacity in some reaches of the flood management system due to levees that constrict the channel and reduce the natural capacity of floodplains to provide flood storage and conveyance, and can cause sedimentation and scour in unanticipated places due to changes in sediment transport dynamics. In addition, in some reaches, existing levees are built on poor or unsuited foundation and cost of retrofit are high or unfeasible. The geology may be far more conducive to a repair by setting the levee back on a more favorable foundation.

Desired Outcome:

Increased flow capacity between the levees and improved structural integrity by constructing setback levees.

Methodology:

Expanding channel capacity by setting levees back from the main river could provide a sustainable approach by enhancing flood system performance and reducing levee erosion over the longer-term. Assessing setback levees would take into consideration various factors, including: existing flood easements; willingness of land owners to participate in the action; ground foundation; existing transportation features and infrastructure; hydraulic modeling; opportunities for habitat, recreation, and agricultural enhancement; and potential erosion reduction.

CVFPP Goals

Contributes Significantly to: Improve Flood Risk Management

Potentially Contributes to (Check all that apply):

- [x] Improve Flood Risk Management
- [ ] Improve Operation and Maintenance
- [x] Promote Ecosystem Functions
- [ ] Improve Institutional Support
- [x] Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retain; look for opportunity.

Advantages:

• Increased floodplain storage reduces the State exposure to flood responsibility.
• More sustainable than traditional levees. Reduces O&M Costs.
• Promotes multiple benefits in addition to reduction of flood risk (habitat, recreation, open space).
• Provides the opportunity to rehabilitate and accommodate fluvial geomorphic processes and flow regimes, increase the quantity, diversity, and connectivity of riparian and wetland habitats, provide access for migrating fish, recreating frequently activated floodplains within a majority of the natural river system.
• Improved structural integrity of levees by using modern construction standards.
• Decrease the geotechnical risk factors by palcing the levee on good foundation.

Disadvantages:

• Potentially high capital cost.
• May result in downstream hydraulic impacts due to increased channel capacity.
• Length permitting.
• Land aquistions and easements for access can be difficult

Economic Considerations:

Capital Cost? (High, Medium, Low)

High capital costs for real estate acquisition and new construction.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

No significant increase in maintenance cost, with potnetial for reduced long-term costs. Reduced channel maintenance costs (vegetation management, sediment removal) and reduced scouring and erosion in comparison to traditional levees may reduce long-term O&M costs.

Potential for Cost-Sharing?

Opportunities to partner with USACE and locals

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Likely reduction in long-term costs for emergency response and recovery through reduction in frequency of flooding.

Flood fighting? (Increase, Decrease, or No Significant Change)

Likely reduction in floodfighting costs through reduction in frequency of flooding. New levee would be constructed to current standards, minimizing the need for flood fighting operations.

Effect on Damage to Critical Public Infrastructure?

Reducing the risk of flooding reduces the likelihood of damage to critical public infrastructure.

Effect on Floodplain and Economic Development?

Reduces the frequency of flooding and increases level of flood protection, which may encourage development in the floodplain.

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Potential to reduce State flood responsibility by reducing the frequency of flooding, unless floodplain development occurs.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

The construction of setback levees could rehabilitate key physical processes by reconnecting channels to historical floodplains, and enhancing sediment transport, channel and floodplain forming processes, groundwater recharge, and improving water quality, and would rehabilitate ecological functions by increasing riparian and wetland habitat area, quality diversity and connectivity, and by increasing spawning habitat (e.g., for Sacramento splittail) and salmonid rearing habitat.

Adverse Environmental Impact?

Constructing setback levees would result in moderate to substantial permanent impacts to terrestrial and agricultural habitats, and potentially to canal or seasonal wetland habitats, and in impacts to associated special-status species.

Permitting Considerations?

Extensive and complex

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

The magnitude of adverse effects to habitats resulting from flood system O&M would be reduced. Setting back levees provides the opportunity to rehabilitate and accommodate fluvial geomorphic processes and flow regimes, reducing erosion and scouring and the need for channel maintenance.

Social Considerations:

Public Safety?

Improves level of flood protection by reducing the frequency of flooding; residual risk remains and may increase if floodplain development increases.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

Can provide open space, recreation, and habitat benefits. Potential for multiple-use trail alignments and connectivity by allowing public access to top of berm.

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Setback levees offer multiple benefits and high in implementation likelihood where feasible. Improving the level of flood protection is politically desirable. Desirable environmental benefits. However, high capital costs and land acquisition challenges may present a challenge to widespread implementation.

Technical Considerations:

Redirected Hydraulic Impacts?

Potential to reduce downstream impacts due to increased floodplain storage capacity

Residual Risk?

Reduce flooding frequency; thereby residual risk.May increase residual risk if floodplain development is encouraged

Climate Change Adaptability:

This action would enhance hydrologic adaptability by increasing water management flexibility. This action also could enhance biological adaptabiity by increasing the quantity, connectivity, and complexity of floodplain habitats and their continuity along environmental gradients; and thus, enhance the ability of species to handle and adjust to the consequences of climate change.

Urban, Small Community, and Non-Urban Considerations:

Construction of new setback levees requires land acquisitions that may not be feasible in urban areas due to land availability limitations.

Regional Applicability:

Construction of setback levees can be limited in some areas due to development and sensitive habitat areas, like the Delta.

Integration with Other Programs:

Flood Projects Office; Fish Passage Improvement Program; Integrated Regional Water Management Program;

References:

USACE 2001 Sacramento and San Joaquin River Basins Comprehensive Study;Environmental Sustainability Summary;Sacramento River Bank Protection Project Draft Environmental Assessment/Initial Study for Levee Repair of 25 erosion sites; Delta R

DRAFT Management Action Evaluation

Management Action Title: MA-023

Construct ring levees.

Description:

Problem:

There are small communities and critical infrastructure that are at risk of flooding, either because they have no flood control protection or the existing flood control protection is insufficient and unreliable.

Desired Outcome:

Protection of small communities and critical infrastructure by construction of ring levees or internal levees.

Methodology:

Reduction in food risk to small communities and individual structures can be achieved by constructing ring levees or internal levees. A ring levee is constructed around the protected area, isolating it form potential flood waters. Internal levees, on the other hand, serve as a second line of defense by compartmentalizing and isolating portions of the protected area. Both ring and internal levees can be used as secondary lines of defense. Ring levees can also act as the primary line of defense in the absence of other forms of flood control. Ingress and egress to the area protected may be difficult if the levee is more than a few feet tall because long ramps may be required to provide vehicular passage over the top of the levee.

CVFPP Goals

Contributes Significantly to: Improve Flood Risk Management

Potentially Contributes to (Check all that apply):

- [x] Improve Flood Risk Management
- [ ] Improve Operation and Maintenance
- [ ] Promote Ecosystem Functions
- [ ] Improve Institutional Support
- [ ] Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retain for further evaluation

Advantages:

• Reduces the frequency of flooding for small communities and structures.

Disadvantages:

• Potentially high capital cost.

Economic Considerations:

Capital Cost? (High, Medium, Low)

High capital costs to obtain real estate and construct new ring levees capable of protecting entire communities.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

Increased O&M costs for new ring levees

Potential for Cost-Sharing?

Opportunities to partner with USACE and locals

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Likely reduction in long-term costs for emergency response and recovery through reduction in frequency of flooding of area surrounded by ring levee.

Flood fighting? (Increase, Decrease, or No Significant Change)

Likely reduction in floodfighting costs through reduction in frequency of flooding in areas surrounded by ring levees. However, in some areas, flood fighting may be impaired if the ring levee is surrounded by flood waters and no protected transportation corridors for ingress and egress are provided.

Effect on Damage to Critical Public Infrastructure?

Ring levees and internal cross levees will reduce the frequency of flooding, and therefore will reduce damages to critical public infrastructure located inside the ring. No impact on critical infrastructure outside of the ring levee.

Effect on Floodplain and Economic Development?

Little to no impact on floodplain development

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Potential to reduce State flood responsibility by reducing the frequency of flooding in the area protected by the ring levee. May increase State flood liability by expanding project-levee system

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

None

Adverse Environmental Impact?

Substantial permanent impacts including loss of terrestrial and potentially wetland habitat, including potential loss of habitat for special-status species, and potential reduction in habitat connectivity.

Permitting Considerations?

Extensive and complex

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

None

Social Considerations:

Public Safety?

Improves level of flood protection by reducing the frequency of flooding in isolated areas; residual risk of flooding remains.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

Levees have the potential for establishment of a recreational trail on top. Loop trails are popular and can be potentially supported by ring levees.

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Improving the level of flood protection is politically acceptable.

Technical Considerations:

Redirected Hydraulic Impacts?

Little to no redirected downstream impacts for smaller ring levees. Larger ring levees may increase downstream impacts of flood events. Internal cross levees do not affect hydraulic conveyance, but control inundation zones.

Residual Risk?

Reduce the residual risk for areas inside ring levee. May increase risk if additional development occurs inside the ring levee.

Climate Change Adaptability:

This action would reduce biological adaptability because it would reduce habitat quantity and potentially habitat connectivity, and thus, reduce the ability of species to handle and adjust to the consequences of climate change.

Urban, Small Community, and Non-Urban Considerations:

Construction of ring levees is most appropriate for small communities.

Regional Applicability:

Construction of ring levees can be performed at any portion of the system where small communities or structures require a greater level of flood protection.

Integration with Other Programs:

Flood Projects Office; transportation corridors

References:

USACE 2001 Sacramento and San Joaquin River Basins Comprehensive Study;

DRAFT Management Action Evaluation

Management Action Title: MA-024

Improve structural performance of existing levees.

Description:

Problem:

Existing levees in certain areas do not have structural deficiencies that make them under increased risk for slope or seepage failures or overtopping. The embankment geometry of certain existing levees is substandard, either narrow crown, short, and/or with steep slopes. These deficiencies may be reflected in persistent slope failures (oversteepened slopes), impaired access to and from levees (narrow crown) or insufficient freeboard (levee too short). Steep waterside slopes on levees adjacent to rivers also promote development or erosional features that further destabilize the levee embankment. Certain levee reaches are prone to develop severe through and/or under-seepage problems during medium- to high-water events. Seepage through the levee embankment may induce internal erosion, surface raveling, and a destabilizing effect on the levee embankment. Under-seepage, manifested by upward flowing sand boils near and away the landside levee toe, washes off fine-grained sediments, reduces the stability of the levee embankment and creates severe internal erosion. Both forms of seepage, if uncontrolled, may result in a levee breach.

Desired Outcome:

Reduce the risk of slope or seepage failure on existing levees

Methodology:

Levees are strengthened to enhance their integrity by improving the embankment soil properties and geometry to resist slope and seepage failures. Improving levee's resistance to slope failure is achieved by enlarging levees through adding material to widen the top width, flatten steep slopes, or both. Material can be added on the landside of a levee to increase stability by widening the crown and/or descreasing the side slopes. Adding material on the waterside can be used in some situations, but is not desired because of constriction to the waterway. Methods to address seepage include seepage berms, impermeable barrier curtains (slurry cut-off wall) in the levee and/or its foundation, and relief wells and toe drains.

CVFPP Goals

Contributes Significantly to: Improve Flood Risk Management

Potentially Contributes to (Check all that apply):

- [x] Improve Flood Risk Management
- [x] Improve Operation and Maintenance
- [ ] Promote Ecosystem Functions
- [ ] Improve Institutional Support
- [ ] Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retained

Advantages:

• Reduces the risk of levee failure and improves reliability.

Disadvantages:

• Potentially high capital cost. Land requirements for increased levee footprint.
• Potentially increased environmental permitting and mitigation costs.

Economic Considerations:

Capital Cost? (High, Medium, Low)

Moderate to high initial capital costs depending on the extent and type of levee modification.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

No change or slight reduction in O&M costs as previous costs associated with levee repairs are minimized.

Potential for Cost-Sharing?

Opportunities to partner with USACE and locals

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Reduces emergency response and recovery costs because of improved reliability of existing flood management system, provided land uses remain unchanged.

Flood fighting? (Increase, Decrease, or No Significant Change)

Reduces flood fighting costs because of improved reliability of existing flood management system.

Effect on Damage to Critical Public Infrastructure?

Reduces damage to critical public infrastructure because of improved reliability of existing flood management system.

Effect on Floodplain and Economic Development?

No effect on floodplain development because of no change to the level of protection from improved reliability of existing flood management system.

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Improved reliability of existing flood management system reduce State financial exposure resulting from catastrophic failures.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

None

Adverse Environmental Impact?

If the footprint of the existing levees is expanded, it could result in substantial permanent impacts to terrestrial habitat including loss of habitat for special-status species. It could aslo moderately alter physical processes (including sediment transport) that could result in permanent impacts to habitat for aquatic and riparian species. In addition, construction related activities could result in substantial permanent impacts to terrestrial habitat including loss of habitat for special-status species.

Permitting Considerations?

Extensive and complex

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

None

Social Considerations:

Public Safety?

Improves public safety by improving reliability of the flood management system (level of protection remains unchanged).

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

No other benefits identified

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Improving the reliability of levees is politically desirable. However, costs and permitting considerations may present a challenge to widespread implementation.

Technical Considerations:

Redirected Hydraulic Impacts?

Minimal impacts

Residual Risk?

No change to residual risk because of no change to the level of protection from improved reliability of existing flood management system.

Climate Change Adaptability:

Improving structural performance of levees would not enhance hydrologic adaptability because system capacity remain unchanged.

Urban, Small Community, and Non-Urban Considerations:

Can be performed systemwide.

Regional Applicability:

Can be performed systemwide.

Integration with Other Programs:

Levee Distress and Levee Improvement Database (HAFOO), Information System Integration (HAFOO), California Levees Database (LRFMO), AB 156 Local Agency Assessment and Reporting (HAFOO), Flood Project Inspections and Reporting (HAFOO)

References: